

TABLE A1: Results of indicator species analysis for 80 understory species present in at least three sites and ten quadrats. Site # represents the number of sites one species was observed out of 30 sites. Quadrat % represents the mean percent of quadrats of one species at sites where it was observed. We used percent for quadrat frequency because the total quadrats number of the two time periods were different. Species identified as indicator species of 1958 were tagged as "loser" in the status column; species identified as indicator species of 2012 were tagged as "winner"; others were tagged with "not change".

Taxon	Site #(1958)	Site #(2012)	Quadrat %(1958)	Quadrat %(2012)	Status
1 <i>Acer rubrum</i>	21	30	31.67	63.87	winner
2 <i>Achillea millefolium</i>	7	1	1.67	0.07	loser
3 <i>Amelanchier spp</i>	14	23	5.00	8.27	winner
4 <i>Andropogon gerardii</i>	6	1	4.83	0.53	not change
5 <i>Anemone quinquefolia</i>	3	9	0.83	2.93	winner
6 <i>Antennaria spp</i>	12	1	5.33	0.07	loser
7 <i>Apocynum androsaemifolium</i>	18	18	6.17	4.67	not change
8 <i>Aralia nudicaulis</i>	13	14	8.33	3.53	not change
9 <i>Arctostaphylos uva-ursi</i>	3	1	1.50	0.07	not change
10 <i>Aronia melanocarpa</i>	0	22	0.00	10.00	winner
11 <i>Aster macrophyllus</i>	14	12	12.17	2.07	not change
12 <i>Aster sagittifolius</i>	10	1	4.67	0.07	loser
13 <i>Betula papyrifera</i>	6	8	2.00	0.60	not change
14 <i>Calamagrostis canadensis</i>	0	4	0.00	0.93	not change
15 <i>Carex spp</i>	6	30	12.17	66.07	winner
16 <i>Chamaedaphne calyculata</i>	0	6	0.00	1.53	winner
17 <i>Clintonia borealis</i>	4	2	3.50	0.73	not change
18 <i>Comptonia peregrina</i>	12	7	5.50	1.67	not change
19 <i>Coptis trifolia</i>	3	6	2.83	2.53	not change
20 <i>Cornus canadensis</i>	11	17	8.17	9.20	winner
21 <i>Corylus americana</i>	11	7	5.00	2.73	not change
22 <i>Cypripedium acaule</i>	3	10	0.50	1.53	winner
23 <i>Danthonia spicata</i>	1	10	0.17	3.33	winner
24 <i>Dichanthelium spp</i>	12	10	3.33	1.53	not change
25 <i>Diervilla lonicera</i>	9	8	5.83	1.27	not change
26 <i>Diphasiastrum complanatum</i>	3	2	0.50	0.73	not change
27 <i>Dryopteris carthusiana</i>	2	12	0.67	4.13	winner
28 <i>Epigaea repens</i>	5	8	1.33	1.00	not change
29 <i>Euphorbia corollata</i>	3	2	3.83	0.93	not change
30 <i>Fragaria virginiana</i>	11	5	3.17	0.60	not change
31 <i>Galium triflorum</i>	0	3	0.00	1.47	not change
32 <i>Gaultheria procumbens</i>	26	28	45.00	20.47	not change
33 <i>Gaylussacia baccata</i>	24	28	31.17	43.67	winner
34 <i>Helianthemum canadense</i>	11	1	8.83	0.40	loser
35 <i>Helianthus occidentalis</i>	4	0	3.00	0.00	not change
36 <i>Houstonia longifolia</i>	7	0	2.00	0.00	loser
37 <i>Ilex verticillata</i>	8	27	3.83	9.93	winner
38 <i>Koeleria macrantha</i>	5	0	2.50	0.00	not change
39 <i>Krigia biflora</i>	12	3	5.67	0.60	loser
40 <i>Lupinus perennis</i>	8	1	8.00	0.07	loser
41 <i>Lycopodium clavatum</i>	0	8	0.00	1.73	winner
42 <i>Lycopodium obscurum</i>	5	7	2.17	3.00	not change
43 <i>Lysimachia lanceolata</i>	0	5	0.00	1.33	not change
44 <i>Lysimachia quadrifolia</i>	23	20	18.50	8.40	not change

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Taxon	Site #(1958)	Site #(2012)	Quadrat %(1958)	Quadrat %(2012)	Status
45 <i>Maianthemum canadense</i>	22	30	27.83	36.80	winner
46 <i>Maianthemum racemosum</i>	5	13	2.50	3.13	winner
47 <i>Melampyrum lineare</i>	7	10	4.00	2.20	not change
48 <i>Mitchella repens</i>	5	20	5.17	20.40	winner
49 <i>Muhlenbergia mexicana</i>	0	6	0.00	1.07	winner
50 <i>Osmunda cinnamomea</i>	0	19	0.00	7.20	winner
51 <i>Osmunda claytoniana</i>	9	6	7.67	0.67	not change
52 <i>Pinus banksiana</i>	9	7	4.17	0.87	not change
53 <i>Pinus strobus</i>	14	28	7.83	30.20	winner
54 <i>Poa pratensis</i>	2	1	2.50	0.13	not change
55 <i>Poa spp</i>	4	10	9.50	3.00	not change
56 <i>Populus grandidentata</i>	1	8	0.17	0.73	winner
57 <i>Populus tremuloides</i>	3	3	0.83	0.87	not change
58 <i>Potentilla simplex</i>	8	9	2.33	1.20	not change
59 <i>Prunus pensylvanica</i>	6	0	7.00	0.00	loser
60 <i>Prunus serotina</i>	1	22	0.33	10.87	winner
61 <i>Prunus virginiana</i>	1	3	1.00	0.27	not change
62 <i>Pteridium aquilinum</i>	25	27	41.83	36.73	winner
63 <i>Pyrola rotundifolia</i>	3	4	0.67	0.47	not change
64 <i>Quercus alba</i>	9	22	3.33	10.27	winner
65 <i>Quercus exr</i>	28	29	36.50	44.80	winner
66 <i>Rhamnus frangula</i>	0	9	0.00	9.73	winner
67 <i>Rosa spp</i>	11	12	4.67	1.80	not change
68 <i>Rubus spp</i>	28	28	43.00	55.40	winner
69 <i>Rumex acetosella</i>	0	5	0.00	0.80	winner
70 <i>Scirpus cyperinus</i>	0	3	0.00	1.27	not change
71 <i>Smilax tamnoides</i>	0	3	0.00	1.13	not change
72 <i>Spiraea alba</i>	1	5	0.17	1.00	not change
73 <i>Symplocarpus foetidus</i>	1	2	1.00	0.47	not change
74 <i>Toxicodendron rydbergii</i>	0	3	0.00	0.87	not change
75 <i>Trientalis borealis</i>	13	27	11.67	26.47	winner
76 <i>Uvularia sessilifolia</i>	21	20	15.17	5.67	not change
77 <i>Vaccinium angustifolium</i>	29	30	60.83	62.73	winner
78 <i>Viburnum acerifolium</i>	2	6	0.33	0.93	not change
79 <i>Viola spp</i>	3	8	0.50	0.87	not change
80 <i>Zanthoxylum americanum</i>	1	2	0.17	2.27	not change

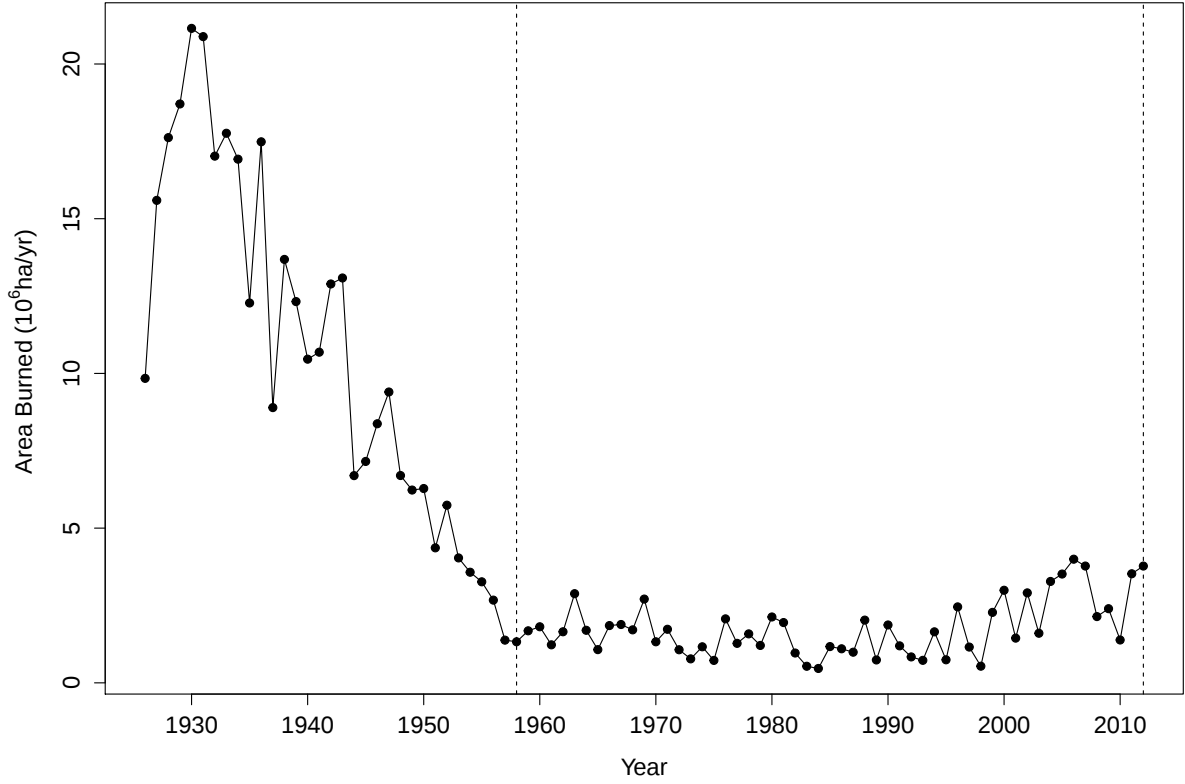


FIG. **A1**: Fire burning extent in the United States in millions of hectares per year from 1926 to 2012. Data of 1926 to 1970 are from the U.S. census bureau (1997, page 536-537, http://www.census.gov/prod/www/statistical_abstract.html); data of 1971 to 2012 are from National interagency fire center (http://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html). The vertical dotted lines are the time periods of this study.

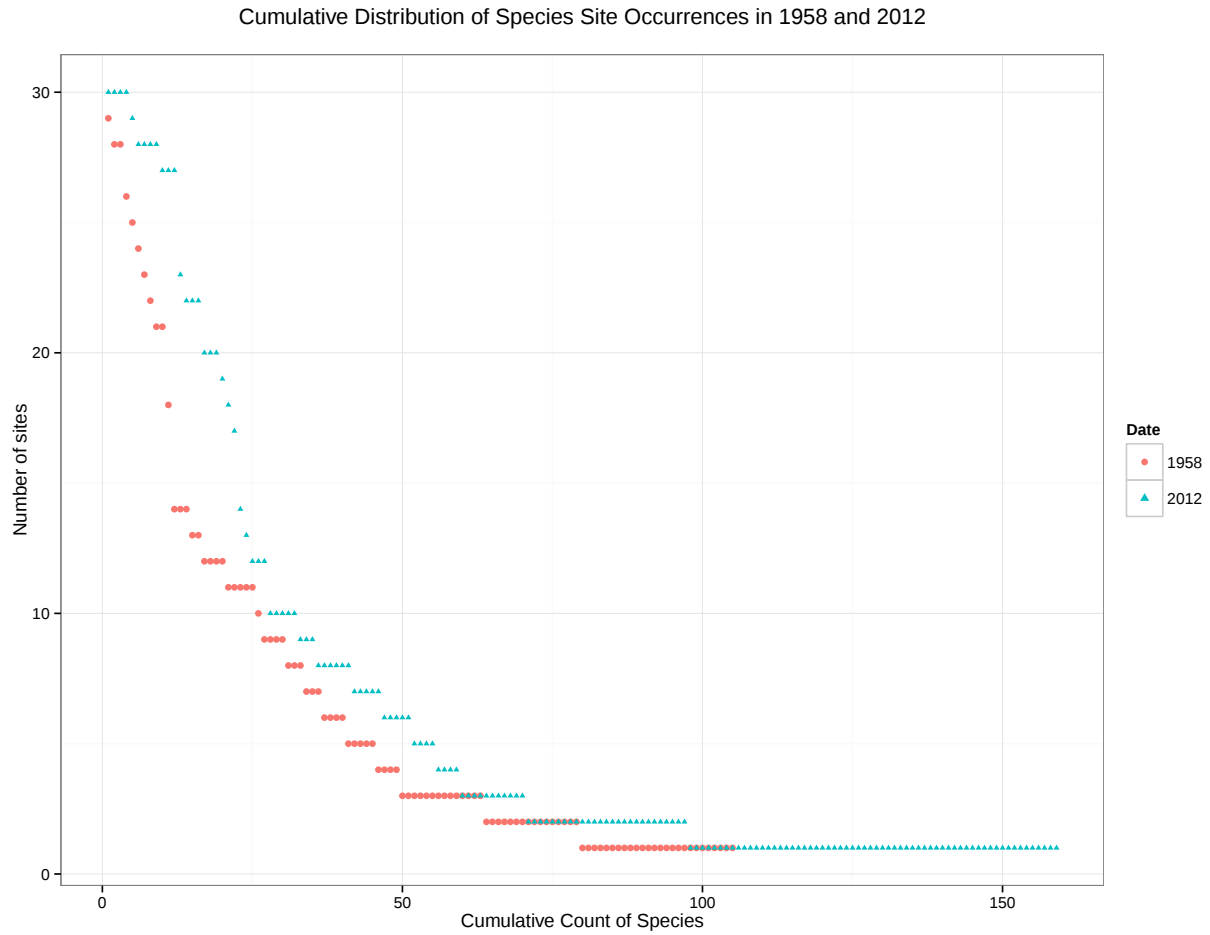


FIG. **A2**: Cumulative distribution of species site occurrences in 1958 and 2012. Singleton and doubleton species in 2012 were much more than those in 1958.

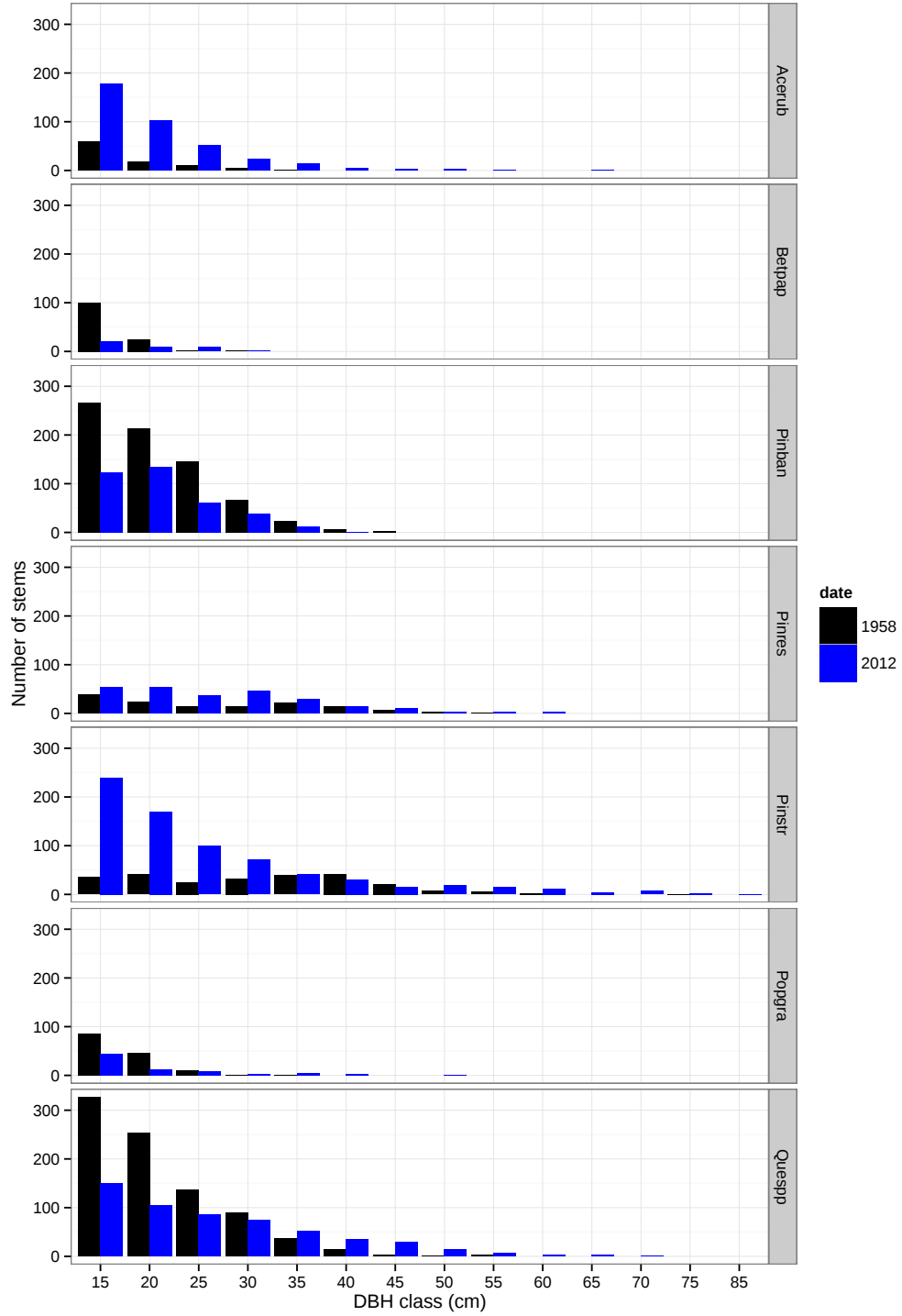


FIG. **A3**: DBH class distribution of common trees in central sand plain sites. Abbreviations are: Acerub, *Acer rubrum*; Betpap, *Betula papyrifera*; Pinban, *Pinus banksiana*; Pinres, *Pinus resinosa*; Pinstr, *Pinus strobus*; Popgra, *Populus grandidentata*; Quespp, *Quercus spp.*

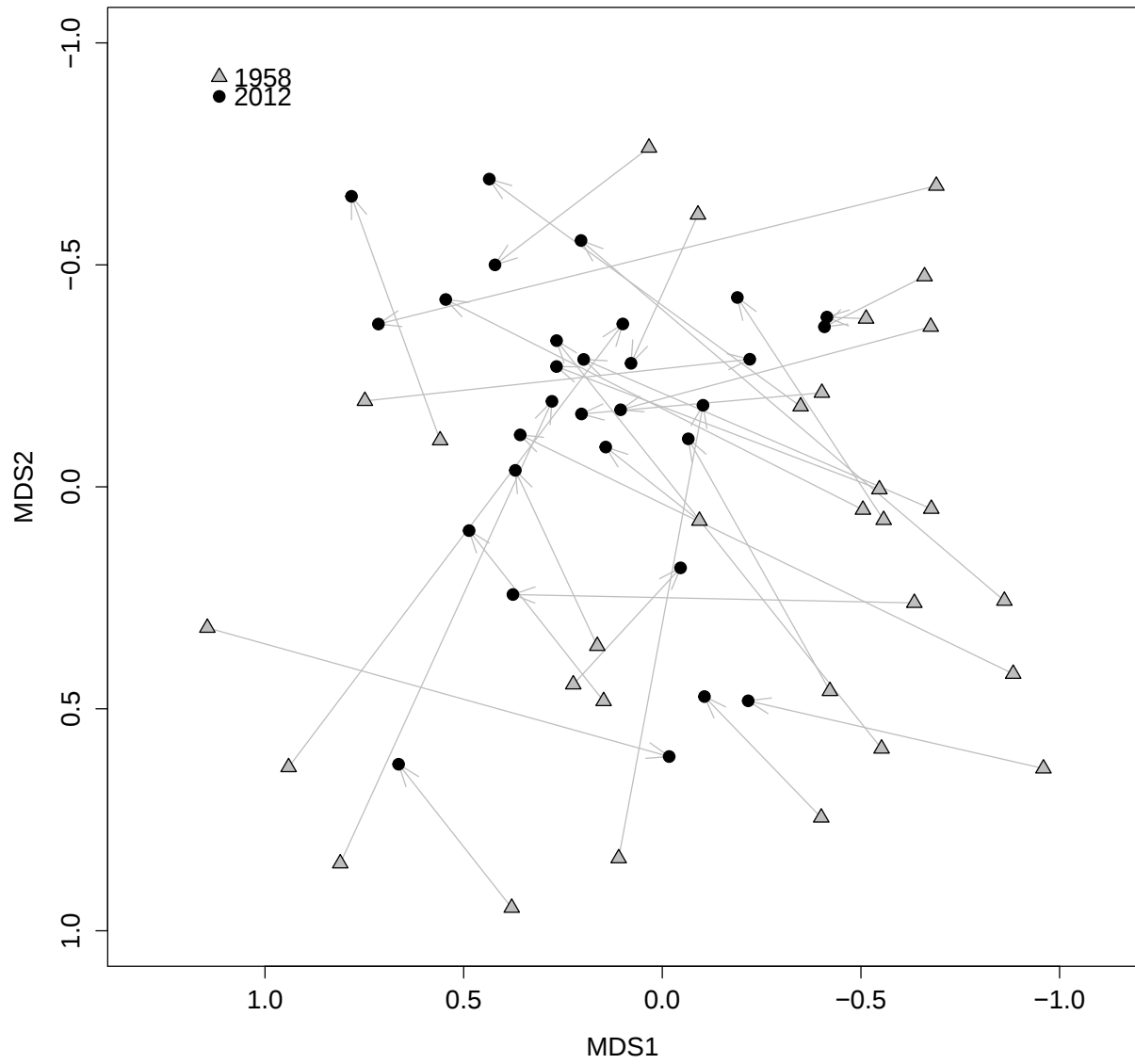


FIG. A4: Non-metric multidimensional scaling (NMDS) ordination illustrated consistent changes (arrows connecting symbols) in overstory species composition of 30 central Wisconsin sites from 1958 to 2012.

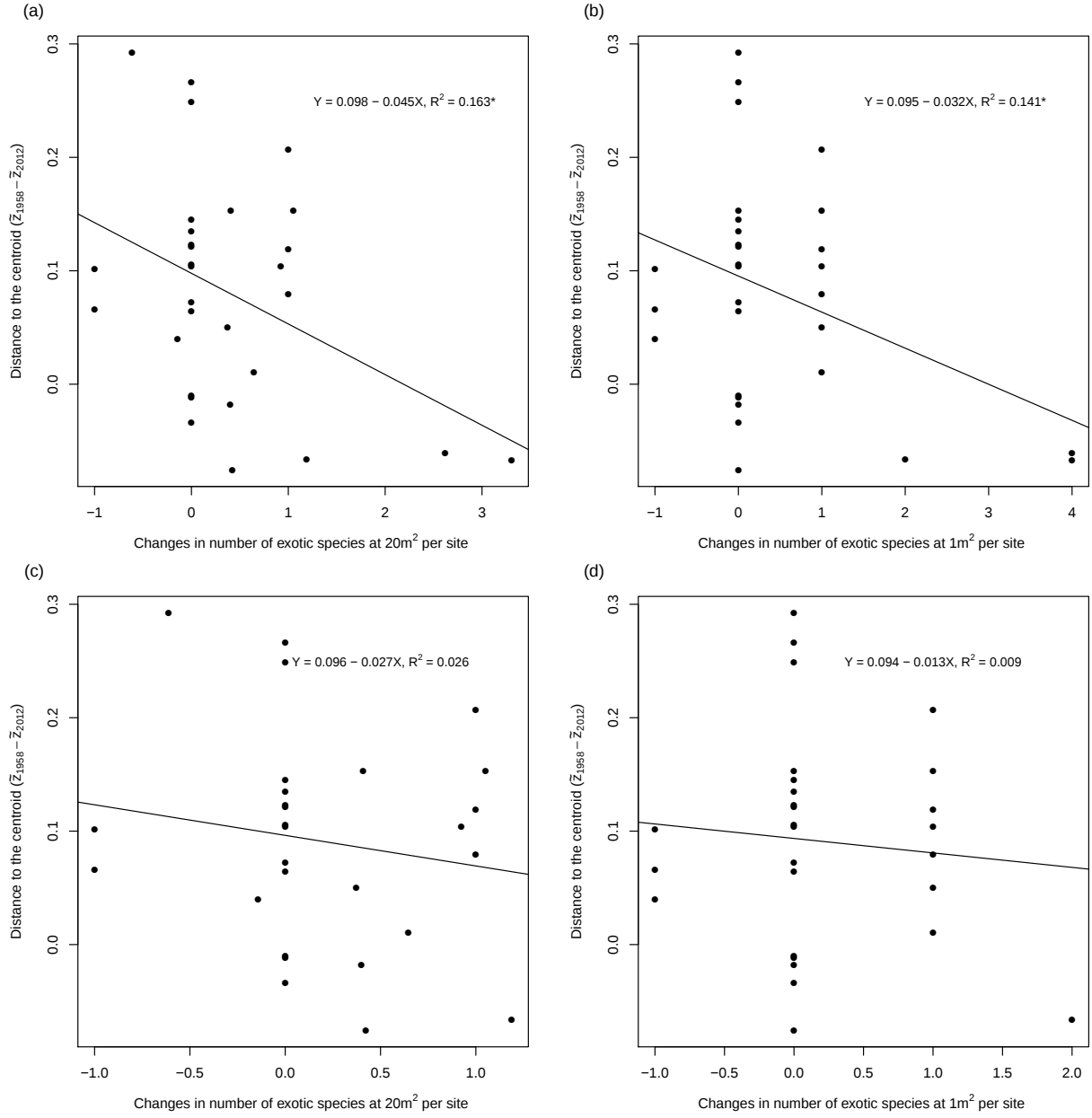


FIG. A5: The changes in distance from the multivariate space centroid over time using understory data ($\bar{z}_{1958} - \bar{z}_{2012}$, > 0 suggests biotic homogenization) (a) decrease with increases in number of exotic species at site-level (20 m^2 , $S_{2012} - S_{1958}$) and (b) decrease with increases in number of exotic species at quadrat-level (1 m^2 , $S_{2012} - S_{1958}$). After excluding two sites increased the most in exotic species, however, these relationships were not significant any more (c and d). All lines are the best fit line by ordinary least square linear regression. *: $p < 0.05$.